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Nakamichi's \$1,100 Cassette Deck



The Equipment: Nakamichi 1000, a stereo cassette deck with true tape/source monitor and Dolby B plus DNL noise reduction, in wood case. Dimensions: 20¾ by 11¾ by 8½ inches (intended for use standing vertically; can be removed from case and rack mounted). Price: \$1,100. Manufacturer: Nakamichi Research, Inc., Japan; U.S. distributor: Nakamichi Research (USA), Inc., 220 Westbury Ave., Carle Place, N.Y. 11514.

Comment: Nakamichi describes its 1000 as a "professional" deck—and that word means something here. (It seldom does in equipment available to the consumer.) Although most of its many special features should have a great deal of appeal to consumers willing to pay the premium price, some (notably the simultaneous recording/monitor and the accessible azimuth controls) take it well beyond the capability range of cassette decks as we've come to know them and into a range that makes possible professional applications that would be virtually unthinkable otherwise.

The front panel is divided into three basic sections. At the left center is the cassette well, which is top loading. This configuration, with the heads above (rather than in front of) the cassette when it's in playing position, produces tape motion from right to left. (Through long habit with conventional left-to-right decks we found this a bit confusing at first; users who have waited for such a professional unit before going to cassettes at all should experience no confusion whatever—even momentarily.) Below are the transport controls: a series of buttons (for pause, recording, fast forward, rewind, stop, and play) that—like those on many modern elevator systems—require no physical pressure for activation, only finger

contact. Each has a small pilot light. Above the cassette well is a pop-out panel that conceals the head-alignment and speed controls. At the upper left is the speed vernier, which the lab found to be close to accurate (0.4% fast) in its "normal" position (which has a detent) at all tested line voltages. The adjustment range exceeded by a small margin the $\pm 6\%$ (approximately a half tone each way) specified for it. Next are two lights used in azimuth (perpendicularity) alignment and a test-tone on/off switch. Below, in the head cover itself, are a screwdriver adjustment for playback head alignment and a small knob for recording-head alignment. Beneath the head cover are (from right to left) the erase head and the first pinch roller, the recording head, the playback head (in the usual centered position), a dummy head that acts only as a tape guide, and the second pinch roller.

The playback head is factory-set for correct alignment, though it can be checked using any of the standard alignment tapes. Azimuth of the recording head is user-adjustable to match that of the playback head. To do this you switch on the test-tone oscillator and record its 423-Hz output on a test cassette. Circuitry within the 1000 compares the phase in the two channels of the signals delivered by the playback head and lights one or the other of the two lights depending on which channel's signal leads the other. As the knob is rotated to correct for the mismatch the two lights begin to flicker on and off alternately; when they light equally, the head is aligned. For the very best results, we did find that rechecking azimuth was advisable before beginning

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recording, particularly in switching from one tape type to another. (Presumably different physical properties in the tape alter the way in which skew—which is present in all tape equipment—affects motion past the head.) But under normal circumstances little readjustment is called for and most users probably will be satisfied to check azimuth only periodically. Either way, the phase-sensing system in the 1000 makes it an extremely simple proposition.

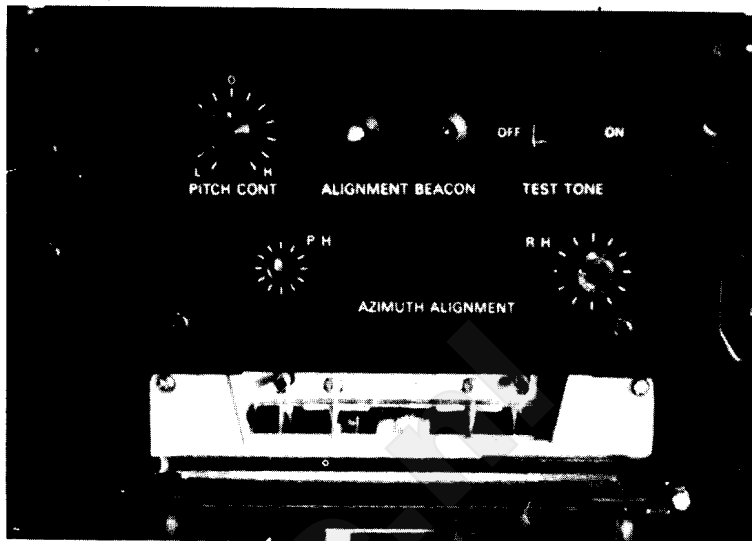
Toward the center of the front panel is the next group of controls: luminous tape-motion indicator, eject button (which causes the cassette holder to open slowly and gently—a far cry from the hyperthyroid action of some eject mechanisms we've worked with), counter and reset button, on/off switches for automatic rewind and for memory rewind, and a stereo headphone jack.

The action of these rewind switches is best explained by recounting one practical use we found for them. We were copying a series of short selections and weren't sure whether enough tape remained for the next number. (A professional probably would have used a timer for this purpose; the amateur can view the window in the cassette case by removing the cover from the cassette well, but the exact quantity of tape remaining can only be guessed at.) Before beginning the next number, we reset the counter to 000 and switched on both the automatic rewind and the memory rewind. Before the number was completed the tape ran out. Instead of just stopping and disengaging (as it would normally do) the transport automatically began rewinding in response to the first switch; when the counter returned to 000 the transport stopped in response to the second switch. We returned to the recording mode to erase the recorded portion of the last number and switched off the automatic rewind. At the end of the tape the transport stopped; we turned over the cassette and began the number afresh at the beginning of Side 2.

The right-hand section of the panel is headed by the two peak-reading meters. Below them are switches for tape (CrO₂/ferric), limiter (on/off), DNL (in/out), Dolby (in/out), monitor (tape/source), and AC power (on/off). The limiter's action is excellent, though the owner's manual correctly exhorts you to use it only to control occasional instantaneous peaks and only on program material that has extreme dynamic range—meaning, typically, live recordings. Along the bottom of this area are pairs of slider level controls for output, line input, and stereo mike input, plus a single slider for "blend mike"—an input that feeds equally to both channels. All inputs can be mixed ad lib. The three mike inputs (left, right, and blend) are phone jacks at the lower right of the panel.

On the back panel there are two DIN sockets: one for a stereo pair of mikes, the other for the normal DIN input/output cable. Most U.S. users will ignore both of these in favor of the domestically standard connections. Those for line input and output are pin-jack pairs next to the DIN sockets. Next comes a multiplex filter switch to keep 19-kHz pilot tones from affecting Dolby action in recording from FM. Then there is a screwdriver adjustment for calibration of the built-in tone generator and similar recording calibration adjustments for each channel and for both chromium dioxide and standard tapes. These adjustments can be used to optimize Dolby action for the tape type actually in use. Also on the back panel is a multipin receptacle for an optional remote-control unit that duplicates the functions of the touchbuttons just below the cassette well.

Many manufacturers throw in little accessories (in ad-



dition to the necessary interconnect cables) with their components. These "bonuses" generally cost the company little yet give the purchaser an extra measure of satisfaction upon opening the box. Nakamichi does more. In a linen-bound "book" very similar in size and appearance to some European multidisc LP sets are a Dolby alignment cassette, a mirror device mounted in a cassette case to facilitate viewing the action of the heads and capstans during servicing, a sample chromium dioxide cassette (for use in making test recordings during alignment), a box containing cleaning sticks with replaceable felt applicators and a bottle of cleaning solvent, a head-cleaning wand, and a dusting cloth for the exposed surfaces of the deck. Like the design of the unit itself, this accessory kit obviously goes far beyond established norms even for a top consumer model.

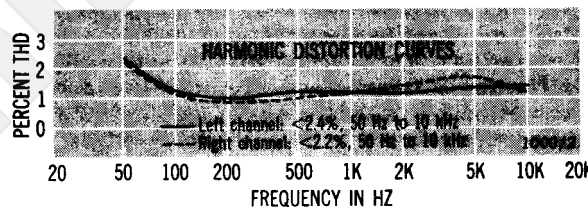
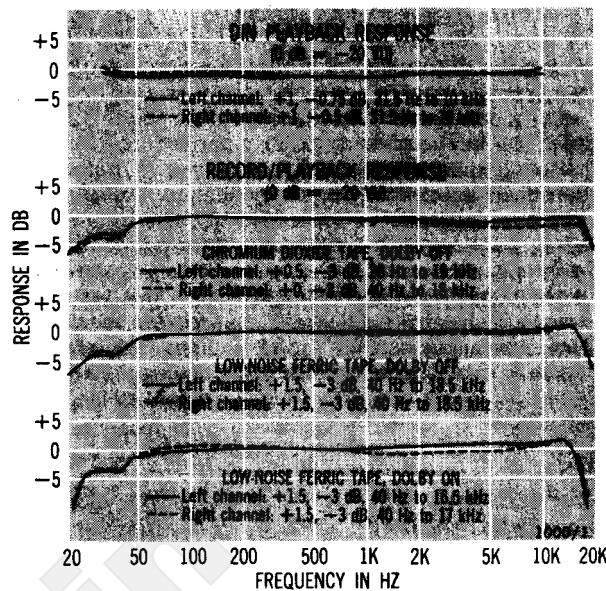
CBS Labs' data show the performance of the 1000 to be very good indeed. Distortion figures are about par for the best cassette decks. Particularly notable is the THD at 10 kHz, a frequency at which distortion usually rises sharply. While we have occasionally seen slightly better figures for IM distortion and for midband THD, we know of no single machine that can be said to better the 1000 in both respects. Similarly, we have seen somewhat flatter frequency response in the extreme bass, but never more extended response at the top; so on averages we would say that no machine we've tested exceeds the linearity and bandwidth of the 1000. (Contributing to its excellent top end, surely, is the separate playback head, which gives Nakamichi the opportunity to use a narrower head gap—and therefore greater high-frequency resolving power—than is normally practical in a combined record/play head.) Wow and flutter figures are, by a small margin, the best the lab has measured so far and is about half the typical values for the better decks. Other measured parameters are about par for a good unit; none is below par.

Even this long description by no means exhausts the subject. For example, we have not mentioned the built-in logic system. When you switch from one transport mode to another, this logic system is carefully designed to time the sequencing of events. Nakamichi's data explain how it works. Let's say you want to record. When you press both "record" and "play" the record bias will be full up within 0.0005 seconds, while tape motion will begin in 0.008 seconds and achieve full speed in 0.1 seconds. Only once this has happened—0.52 sec-

Speed and head-alignment controls are at top. Light in left-hand "beacon" normally means that the record-head alignment knob (RH) should be turned clockwise; here it means only that this light flashed on in time with our shutter. Special mirror cassette is in position, affording a view of playback head (center, actually hidden from direct view behind alignment-control plate).

onds after the buttons are pressed—will the recording current and playback amp switch on. At 0.59 seconds the recording current will be full up and at 0.75 seconds the monitor amp will be too. All this avoids audible start-and-stop wows and switching transients in the monitor circuit. It does have one (very minor) drawback, however. If you are piecing a recording together by using the pause control, the slight discontinuity in recording current will introduce a momentary "dropout" and very faint switching clicks wherever you have used the pause. If you choose your edit points in silent passages, only the clicks can be heard—though barely; with noisy backgrounds (for example between numbers of a live concert) the "dropout" becomes audible. The effect lasts only about a half-second; otherwise the performance of the logic system is extremely elegant.

So is the over-all "feel" and operation of the unit. It is a little awing to work with a unit costing more than twice the price of anything else on the market, but a source of great satisfaction—if you are willing to expend the degree of care that the deck deserves—to work with a unit that will do things no other cassette deck on the market can manage. The ability to monitor playback while you are recording is—as open-reel recordists have known for years—an important one for really fine results. Malfunctions, excessively high level settings, and incorrect equalization all will make themselves heard if you can listen to the tape rather than the source while you work. (Other monitor-head cassette equipment has been announced, but this is the first production sample we've seen.) When you want noise reduction in the recordings you're making, the Dolby B system is there; when you want to reduce apparent hiss without audibly affecting the music, the DNL system is there as well. These two can be used simultaneously. In copying from slightly hissy tapes we used the Dolby circuit in recording to avoid adding any more hiss and the DNL (which operates in the playback circuit only of course) to suppress the hiss already there. The ability to optimize Dolby action and azimuth for best possible performance with any tape you may choose to use certainly is important too. But most important of all, we were unable to find any signal source with anything like a normal dynamic range that could not be reproduced on the 1000 so faithfully that we were unable to distinguish between the copy and the original. All told, a unique and fascinating product.



Nakamichi 1000 Additional Data

Speed accuracy (pitch control set at "0")	0.4% fast at 105, 120, and 127 VAC	
Wow and flutter	playback: 0.06%	record/play: 0.07%
Rewind time, C-60 cassette	56 sec.	
Fast-forward time, same cassette	56 sec.	
S/N ratio (ref. DIN 0 VU, Dolby off)		
playback	L ch: 53.5 dB	R ch: 54 dB
record/play	L ch: 51 dB	R ch: 51.5 dB
Erase (400 Hz at normal level)	61 dB	
Crosstalk (at 400 Hz)		
record left, play right	36 dB	
record right, play left	40 dB	
Sensitivity (for 0-VU recording level)		
line input	L ch: 125 mV	R ch: 120 mV
mike input	L ch: 0.50 mV	R ch: 0.50 mV
blend mike input	0.55 mV	
Meter action	adjustable	
IM distortion (record/play, -10 VU)		
L ch: 6%	R ch: 5.1%	
Maximum output (line, 0 VU)		
L ch: 1.25 V	R ch: 1.25 V	

Audio

Equipment Profiles

MARCH 1974

Successor to **RADIO** Est. 1917

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Nakamichi Tri-Tracer 1000 Cassette Recorder



MANUFACTURER'S SPECIFICATIONS

Wow and Flutter: Less than 0.10% (DIN). **Frequency Response:** 35 to 18,000 Hz \pm 3 dB, Low Noise Tape; 35 to 20,000 Hz \pm 3 dB, CrO₂ tape (both using Dolby). **Signal-to-Noise:** Better than 60 dB (DIN), Dolby, weighted at 3% distortion. **Total Harmonic Distortion:** Less than 2%, 0 VU, 1 kHz. **Channel Separation:** Better than 35 dB, 0 VU, 1 kHz. **Bias Frequency:** 105 kHz. **Headphone Output:** 3 mW. **Dimensions:** 20.7 in. W x 11.7 in. H x 8.6 in. D. **Price:** \$1,100.00.

The Nakamichi 1000 must surely be considered the Rolls Royce of cassette recorders with its two noise reduction systems (Dolby and Philips DNL), variable speed, separate record head with monitoring facilities, IC logic control, and a host of other features. It is intended for professional users but it will obviously appeal to many enthusiasts who want state-of-the-art performance—and can afford the \$1100! The unit is housed in a wooden case for vertical operation but it is available for rack mounting if desired. At the left is the cassette compartment and just above that is a hinged

door covering the speed control and head alignment controls (see Fig. 2). Adjustment is simplicity itself and it works like this: A built-in oscillator or generator supplies a 400 Hz signal which is recorded on the tape. Output from the recording and playback heads is taken via a phase-comparison amplifier to two LED indicator lamps called alignment beacons. All the user has to do is turn an adjustment control so that the lights are balanced. The control affects only the record head. In other words, it is matched to the playback head which is aligned at the factory. There is an azimuth adjustment for this head and it can be checked with a standard test tape if necessary. Incidentally, tape motion is from right to left and the heads are mounted above the tape. The tape speed control gives a variation of \pm 6% in playback only and it is labelled PITCH CONTROL.

Under the cassette compartment are six touch-control buttons labelled PAUSE, RECORD, F. FORWARD, REWIND, STOP, and PLAY and each one has an indicator light. To the right of these controls is a small panel on which is mounted the tape counter, EJECT button, AUTO REW and MEMORY rewind switches plus a headphone jack. The MEMORY rewind switch allows the tape to be wound back to a preset point and the AUTO REW switch will automatically ensure that the tape will be rewound at the end of the tape—a useful device! At the top right are the two large VU meters (peak reading), and underneath them are switches for TAPE SELECTION (NORMAL and CrO₂), LIMITER, DOLBY and DNL noise reduction and tape-source MONITOR. To the right is the ON/OFF switch and three MIC INPUT sockets—one for each channel and one for center, or BLEND. To the left of these

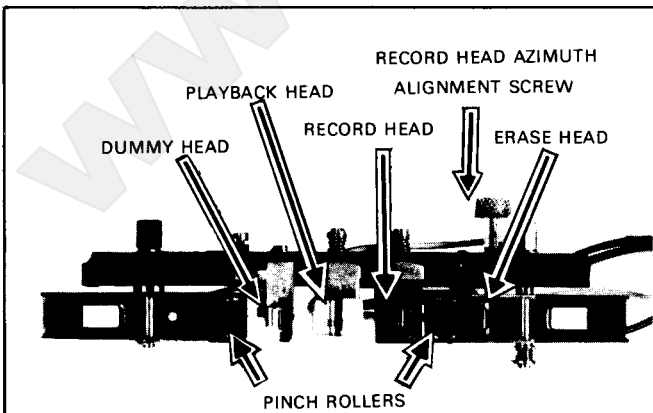


Fig. 1—Head configuration.

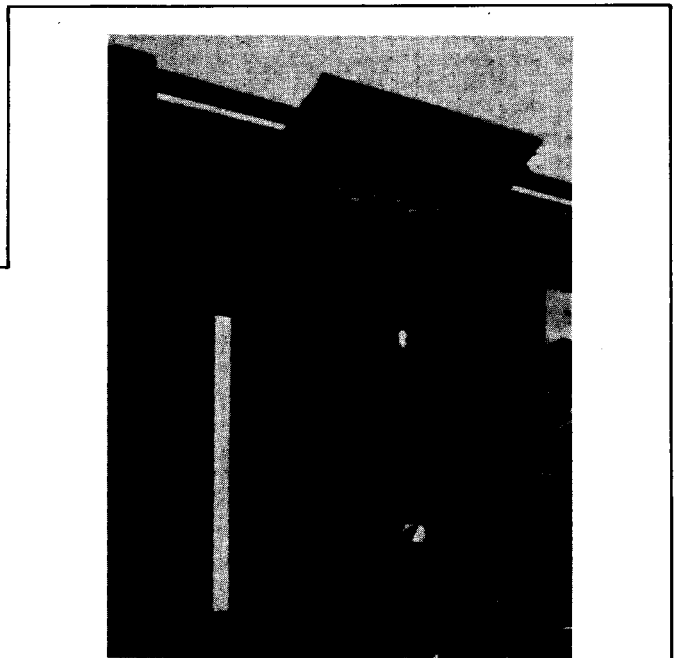


Fig. 2—Showing compartment containing speed and head alignment controls.

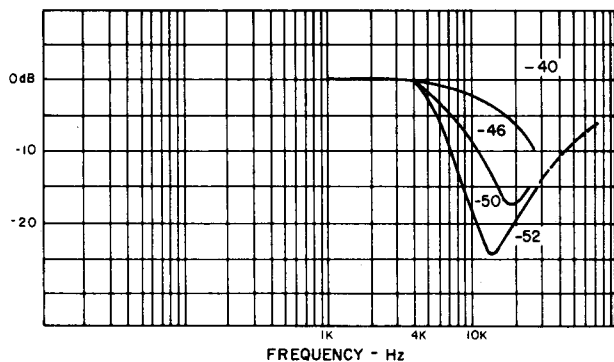


Fig. 3—Showing operation of the DNL noise reduction system.

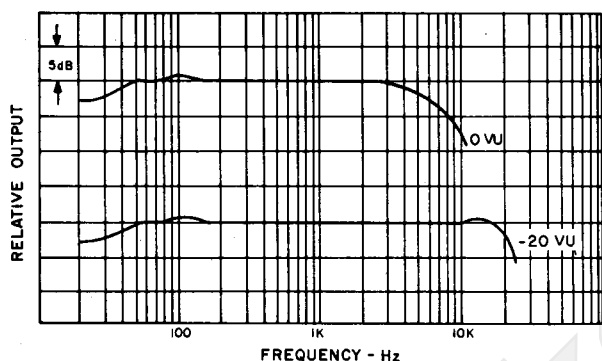


Fig. 4—Record-replay response with Nakamichi CrO₂ tape.

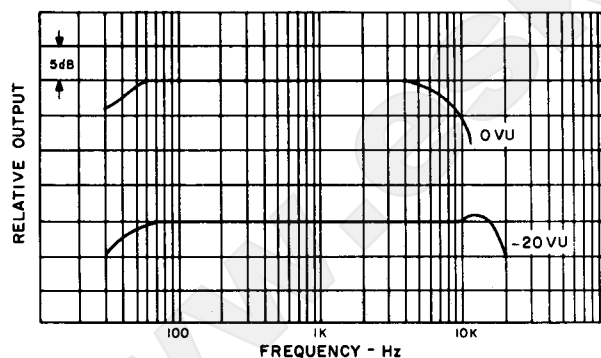


Fig. 5—Record-replay response with low-noise tape.

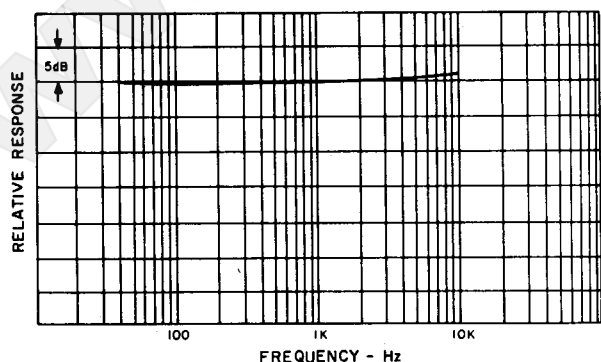


Fig. 6—Response from standard playback tape.

are twin slide controls for OUTPUT, LINE INPUT, and MIC INPUT and a single one for the BLEND MIC position. Finally, at the top center is an illuminated tape run indicator. At the rear are the input and output sockets, test-tone level control and calibration controls for both CrO₂ and NORMAL tapes. There are also two DIN sockets (one for stereo mic) and an MPX switch that cuts response above 18 kHz to prevent the FM 19 kHz carrier from interfering with Dolby operation and—I almost forgot—a socket for a remote control unit.

Model 1000 employs no less than 138 transistors, 59 diodes and 8 ICs. A very complex logic circuit is used for precise control to ensure foolproof, effortless operation and freedom from click noise. Thus, if you want to record when the machine is in the STOP position, you press (or rather touch) the appropriate buttons and the sequence of events is as follows: First the bias oscillator is switched on, then after 100 milliseconds the head moves to position and the pinch roller starts to rotate. When the tape movement is stable (520 mS), the record amplifier is turned on and is ready after 70 mS. Finally, after 790 mS the playback amplifier is turned on. When recording stops, first the recording amplifier is switched off, then the bias oscillator slowly "dies" and the playback amplifier is switched off—the whole sequence taking 200 mS.

As mentioned above, two noise reduction systems, Dolby B and Philips DNL, are used and it might be thought that this is really gilding the lily or at least extravagant. However, a moment's thought will show that these two systems are not incompatible but actually are complementary. As most readers know, the Dolby system functions by boosting high frequency signals during recording and then reducing them at playback (A simplified explanation, but it will suffice). Now, the DNL is rather different in that it works only during playback. Frequencies above 4 kHz are cut in proportion to level as shown in Fig. 3. Note that the maximum effect is in the region of 10 kHz and that the system has virtually no effect above levels of -40 dB. So the DNL system can be used on playback with ordinary tapes and the Dolby reserved for recording. Can you use both together? The answer is yes, and the total noise reduction is then about 13 dB. For most purposes, it is probably better to use them separately as suggested.

The main play-transport motor is a servo-controlled phonic wheel d.c. type and a double capstan is used with staggered heavy flywheels. A second motor handles fast forward and rewind. Because there are separate record and playback heads, each can be designed for optimum results. Thus, the gap in the record head is 5 microns but the playback head has an exceptionally small gap of only 0.7 microns! This enables the high-frequency response to be maintained up to 20 kHz or so, but it does mean that care must be taken to keep the heads clean and aligned properly. Figure 4 shows the record-replay response from the Nakamichi CrO₂ tape supplied, and Fig. 5 shows the response with low-noise tape, also Nakamichi. The chromium dioxide tape has a wider response (3 dB point at 21 kHz against 19 kHz) but the difference in practice is small. Incidentally, the tape selector switch is marked CrO₂ and NORMAL, but in this instance NORMAL refers to low-noise tapes like TDK SD or Maxell UD and so on. Figure 6 shows the response from a standard playback tape and distortion is shown in Fig. 7. Distortion at 0 VU was a low 1.4% increasing to 3% at +3 VU. Distortion versus frequency can be seen in Fig. 8. Signal-to-noise measured 53 dB (ref. 0 VU) increasing to 63 dB with Dolby. Some makers still use a 3% distortion reference figure which would make the figures 56 and 66 dB respectively. Erasure, with CrO₂ tape, was 66 dB. Line input sensitivity was 100 millivolts and microphone sensitivity was just under 0.5 mV—0.45 mV to be

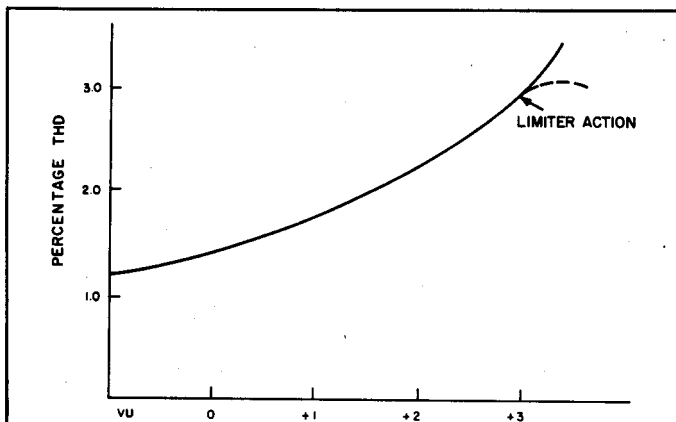


Fig. 7—Distortion at 1 kHz. Dotted line shows limiter action.

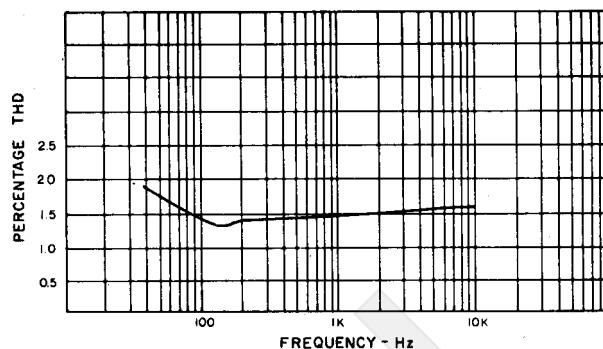


Fig. 8—Distortion versus frequency.

precise. Output for 0 VU recording level was 1 volt. Wow and flutter came out at 0.17% unweighted peak which corresponds to a weighted figure of about 0.06% (DIN 45507). This, incidentally, is the best we have ever measured for any cassette recorder. Rewind time was 57 seconds for C60 cassettes.

The first thing I did after making sure everything was OK, was to check the head alignment. It was right on the nose but the adjustment was investigated to see how well the device really worked. Once you got used to the time delay, there was no difficulty whatever and even the most ham-handed novice can get perfect alignment every time. So, full marks to Nakamichi for a most ingenious idea! After the various measurements were taken, recordings were made with and without the Dolby system, and they compared very favorably with those made with a standard open-reel machine. The DNL system was used on occasion and it certainly helped when playing back some old tapes. It was not found necessary to use the limiter, although it might well prove useful when making direct recordings. The controls themselves, especially those feather-touch buttons, were a joy to use. The eject button does *not* throw the tape half-way across the room, and it cannot operate when the tape is running. In fact, none of the

tape controls will function until the STOP button is touched—that logic system is foolproof!

The 1000 comes complete with a large linen-bound folder or case in which are cleaning sticks and solvent, a Dolby alignment cassette, a special cassette with a built-in mirror so you can see the heads, a CrO₂ cassette, a head cleaning wand and a dusting cloth. The comprehensive technical manual also includes an individual specification sheet with a frequency response curve.

Summing up: The Nakamichi 1000 is definitely a state-of-the-art cassette recorder. Because of the low tape speed and reduced track width, cassette tapes are severely handicapped with respect to open-reel, but with the use of separate record and playback heads, accurate alignment, plus efficient noise reduction systems, Nakamichi has achieved results which would have been thought absolutely impossible not so long ago. Not only that, but they have come up with a professional machine that is even simpler to operate than an ordinary domestic recorder!

Memo to Nakamichi—please do not ask me to return the recorder yet!

George W. Tillett

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